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SOIL CONSERVATION

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SOIL CONSERVATION

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WELLINGTON BRINK EDITOR

CONTENTS

Front Cover: Betty Mueller with an armful of oats, on the John Mueller farm near Winona, Minn., July 1944. The grain is grown there in contour strips, of course. Photographer: W. H. Lathrop.

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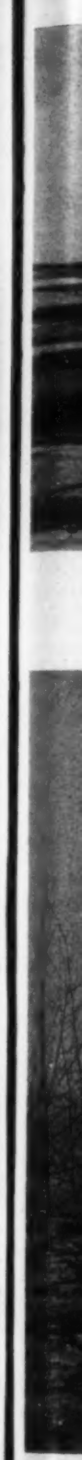

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Shelterbelts in the Great Plains

Shelterbelts clear to the skyline. An area south of Mitchel, S. D.

By JOHN W. KELLER

Part of a 30-acre planting in the Park River area, N. D. Even in 1939 when this picture was made windbreaks and farmstead planting had vastly increased the value of the land.

In the Great Plains prolonged droughts and strong winds have intermittently harassed the rural population and made agriculture insecure. These hazards can not be eliminated entirely and any factors that aim to ameliorate them and temper their devastating effects are readily grasped by farmers and ranchers.

The planting of trees long has been recognized as a practical means of checking the effects of strong winds and the many harmful results to agriculture that accompany them. The purpose of belts of trees in the Great Plains is to deflect and slow up winds near the ground. Where this can be accomplished, it will temper the hot, dry winds of summer and the cold winds of winter, check the devastating dust storms which carry away the top soil, prevent excessive evaporation, and retain soil moisture for the production of agricultural crops.

Shelterbelts are now one of many conservation practices useful in the program of soil conservation districts, particularly in the Great Plains region.

History

Tree planting to conserve moisture for crops has been successful in Europe and, coming closer to home, in Canada as well.

EDITOR'S NOTE.—The author is assistant chief, Forestry Division, Soil Conservation Service, Washington, D. C.

In Eastern Russia shelterbelts have been planted in the steppes from the Black Sea to North of the Caspian on land that in many respects bears close resemblance to our own prairie region. The results of established shelterbelts in Russia were so favorable that the planting of over 800,000 acres of shelterbelts was included in the Soviet second 5-year plan, of which we heard so much before World War II.

In Hungary the climate, soils and precipitation southeast of Budapest are quite similar to our prairie region. Here the planting of shelterbelts for the protection of orchards, vineyards and cultivated fields has been common for many years. Legislation in Hungary in 1923 provided for a definite system of shelterbelts which were to be planted by the farmer who in return would receive planting stock at nominal prices and a reduction of taxation. These shelterbelts are reported to reduce evaporation of soil moisture, promote the formation of dew, retain litter and snow, stabilize sandy soils, protect flowering, hasten the ripening of fruit, decrease breakage of fruit trees, decrease premature fruit dropping and reduce the dust. These beneficial effects are attributed largely to a reduction of wind velocity.

In Denmark shelterbelts and hedges of trees and shrubs have proved to be the most satisfactory means of reducing high wind velocity and attendant damage. Strong winds from the North Sea in Jutland gradually buried under drifting sand a large area of once fertile agricultural soil. It is claimed that these strong winds destroy gardens, damage plants and buildings, dry out sod and whip the grain in the fields if unprotected by shelterbelts. The Danes attribute to shelterbelts favorable local effects upon air and soil temperatures, wind velocity, evaporation, relative humidity of air in local areas, and increase yields up to 30 percent for some crops.

In the prairie region in Southwestern Manitoba and portions of Saskatchewan and Alberta the soil topography and climate are quite similar to those in our Great Plains. Governmental aid and encouragement to shelterbelt plantings have assisted the development of planting methods and the testing of tree species. Early settlers in Canada planted thousands of trees about their homesteads but failures were general because of unsuitable species and lack of experience in tree culture under those rigorous conditions. In 1901 the Dominion government established experiment stations and a system of cooperative planting was begun whereby farmers were supplied with planting stock free of charge if they would carefully follow instructions in planting, cultivating and caring for the trees. Under this system the plantings are reported to be generally successful.

The beneficial effect of trees was recognized in the United States at an early date and legislation has been enacted through the years in an attempt to compensate for land misuse. In the United States the Great Plains comprise about 30 percent of the continental United States. As civilization traveled westward and increasingly large areas of sod were broken, frequent droughts and dust storms resulted in increasing economic loss and human discomfort and suffering. Tree planting was one of the first measures to relieve this distress. The Timber Culture Act of 1873, the Kincaid distribution in the agricultural appropriation act of 1911, the establishment of experiment stations in 1913, the Clarke-McNary Act of 1924 and numerous State laws encouraged tree planting. Unfortunately many of the early plantings not only received little or no care, but they were severely handicapped by heavy grazing. However, a few of them stand today as monuments to the foresight and painstaking care of the early settlers.

The planting of shelterbelts in the Great Plains is advisable wherever soil, precipitation and other climatic conditions do not forbid tree growth and where agriculture is sufficiently developed to need the protective influence of trees. All of the evidence available from studies that have been made and from the experiences of farmers and ranchers who have shelterbelts indicate that the plan for shelterbelts in the Great Plains is sound.

Specifications

Foresters think that trees should be planted close together so that the branches will grow together quickly and eliminate the necessity of cultivation. Foresters also claim that close planting with closed borders and complete protection from fire and grazing will develop a "forest" soil. Such a soil with its litter cover and permeable physical structure will conserve and store moisture to be used for the growth of the trees.

The spacing of early plantings included a variety of widths between rows, of spacing within rows, and of number of rows. Shelterbelts contained from 1 to 20 rows and these rows were from 8 to 12 feet apart with 10-foot isolation strips on each side. The distances apart in the rows of 2 to 8 feet were varied with the species. One, two and three row belts have been success-

fully planted and maintained and have been effective in Oklahoma and Texas. Further north where snows are frequent, wider belts tend to collect the snow in drifts thus materially increasing the moisture for tree growth. The loss of a few trees in a narrow belt, which permits the wind to sweep through the openings, may destroy

Shelterbelts such as this help to harness the wild winds that come roaring across the plains. They protect land, wildlife and man, and at the same time add a touch of beauty.

A barrier against the fiercest wind, as reared in Burt County, Neb. The trees form a triangle-shaped shelter, with the slower-growing species at the left and the more rapidly-growing species at the right.

the effectiveness of the entire shelterbelt. The additional land and expense required to plant a few extra rows is the cost of insurance against possible complete or partial failure. Five to ten rows varying in height from shrubs to tall trees are now favored over the wider belts that were established a few years ago. The graduation in height from low shrubs on the outside of the belt to high trees in the center imparts an upward sweep in the air currents. The effect is felt to some extent at distances to leeward as much as 50 times the height of the trees. Twenty times, however, is usually considered to be the practical limit of effect.

We know now that zones or solid belts of trees from the North to the South as originally contemplated would have been a mistake, and in fact such planting never was attempted. The direction of the belts is carefully selected in relation to the prevailing winds. Sometimes they run North and South, sometimes East and West, and at many locations they are established in both directions to control winds during different periods of the year. The important problem is to locate the trees so that most of the air currents are dispersed before they get strong enough to damage agricultural crops. East-West belts frequently give this protection against summer winds but will not provide protection against the quartering winds of winter. It is because of the variableness of wind direction that belts in both directions are necessary. The frequency of belts depends upon the local conditions and the degree of protection necessary. Usually the intervals do not exceed 1/4 mile and under some conditions it may be advisable to have them as close together as 1/16 of a mile.

Species and Arrangement

In planning a shelterbelt, certain kinds of trees and shrubs are better than others. A great number of shrubs and evergreen and broadleaf trees have been planted during the past 50 years with varying degrees of success. The choice of species depends upon their adaptability to climate and soil, their susceptibility to insect and fungus damage, their economic and aesthetic values, and the degree of protection required. The hardwood trees found to be most useful in the Plains are cottonwood, green ash, American and Chinese elm and honey locust. Evergreens that have thrived best are eastern red cedar, Rocky Mountain red cedar, Austrian and ponderosa pine. Shrubs best adapted are Russian olive, Siberian pea, wild plum, lilac and choke cherry. The arrangement of rows usually provide shrubs on the outside, evergreens next, tallest broadleaf trees in the center.

Protection and Care

Shelterbelts must be protected and, until well established, they should be cultivated. Trees will not live or a shelterbelt be effective if browsed and trampled by livestock. In early stages the trees are easily killed by competition of grass and weeds. Three to 5 careful cultivations annually are needed during the first 5 to 6 years after planting. This removes weed competition, aerates the soil, and puts it in better condition for holding moisture. Dead and diseased trees should be removed. The trees in the interior rows may be pruned, but no pruning should be done on the outside trees nor on any of the evergreens or shrubs. Trees that die during the early part of the life of the shelterbelt should be replaced the following planting season. When planted close together the trees crowd each other and suppressed trees will eventually die. Suppressed trees may be removed while the wood is still sound.

Influences

The direct and indirect results from shelterbelts in the Great Plains have been studied by numerous federal and local agencies. Many of these surveys pointed to benefits that were so great that most of the results were never published. Long time records of the influence of shelterbelts on crop yields in the United States are not available. The experiments that have been carried out indicate that shelterbelts not only hold the soil in place and control wind erosion but, in addition, crop yields have been increased, livestock has required less winter feed, farm buildings have needed less fuel, and farm gardens have produced more abundantly. One careful survey conducted in South Dakota shows that farmers who have shelterbelts believe that trees add $1,000 to the value of each 160 acres.

Shelterbelts become a source of post and fuel material for the farmer after the belts have attained an age of 10 years and older. Desirable wildlife, game and insectivorous birds seek protection and propagate within the shelterbelts. This wildlife frequently is a source of food and recreation and the aesthetic value of the trees should not be discounted. In fact shelterbelts offer shade from the sun, shelter from the wind, improved appearance to the area, and increased value to the land. These factors add to the stability of farm life.

Agriculture in the Plains States without trees is hazardous. The best proof of the value of shelterbelts comes from the farmers who have them. These farmers even under war time restrictions and manpower shortage and without governmental aid except for free trees, are continuing to plant shelterbelt trees by the hundreds of thousands.

Disadvantages

Most of the disadvantages reported as a result of shelterbelts arise from badly selected locations. On any farm, trees in the wrong places are a handicap, not a help. It is true that shelterbelts break up large fields into tracts that are inconvenient and economically difficult to handle with heavy machinery. In some locations they may cause snow to collect in drifts on roads and about buildings, and may encourage late spring frost if they cut off air movements near the ground. However, the positive disadvantages of shelterbelts are so few and so trifling when compared with the benefits that only brief mention is necessary. In fact, the shelterbelts that have been established in the Great Plains stand as markers to the practical ideal of the pioneers who strove to bring forest benefits to a treeless region.

Future Plantings

Shelterbelts have been incorporated into the conservation program administered by soil conservation districts, with excellent results. The planting of shelterbelts as a separate project was discontinued in 1942. Since that time no special appropriations have been available but the work continues to go forward as a part of the farm conservation program that the Soil Conservation Service is carrying on by assisting soil conservation districts. Up to March 1, 1945, soil conservation districts have been organized over almost 45 percent of the area included in the Prairie States Forestry Project. New soil conservation districts are being formed rapidly within the remaining 55 percent of the area and indications now are that within a year and a half after the war between 60 and 80 percent of the Great Plains probably will be covered by locally governed soil conservation districts.

Outside of organized soil conservation districts the Soil Conservation Service is assisting farmers to establish shelterbelts to a limited extent as a part of the widespread conservation program. The Service has assisted 44,500 farmers and the Prairie States Forestry Project during its active life has helped 33,000 to establish shelterbelts.

Experience over a period of 10 years leads to the conclusion that a shelterbelt program sponsored and directed by local farmers and land owners with broad over-all federal coordination is more successful than a huge federal one-practice project. Programs sponsored by local groups under the leadership of the people who have a direct interest in the land are built upon a firm foundation. This has been proved by the Soil Conservation Districts in the Northern Great Plains during the war years of 1943 and 1944 where, notwithstanding the handicap of shortages of man power and planting stock, more than 5,000,000 trees have been planted.

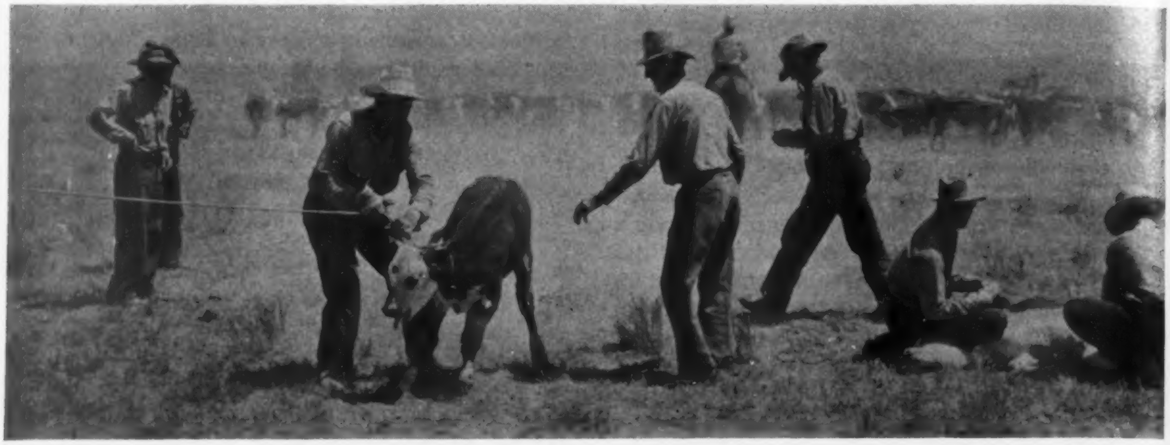
Shelterbelts are far from being a cure-all for agricultural problems in the Great Plains. They constitute but one of the many conservation practices that are being recommended. Other practices include rough tillage, crop rotations, cover crops, pasture contouring, terracing, diversion ditches, stock water tanks and ponds and many others. Correct land use, according to the needs and adaptability of the land, is essential on each farm. To give technical assistance to effect these practices is the foundation of the integrated farm conservation plan that is the basis of the work of the Soil Conservation Service, not only on the Great Plains, but throughout the United States.

Pinning Down the Sand

"The Dunes Stood Still" is the title of an article by Neil M. Clark in the April 28 issue of The Saturday Evening Post. It describes the levelling and successful regrassing of the Caddoa dunes in Colorado which permitted operation of a railroad through the area and greatly simplified a problem in war transportation.

Mr. Clark writes: "Soil experts say we have made millions of acres of deserts in this country by overplowing and overgrazing low-rainfall areas of the West. Lately the United States Soil Conservation Service gave dramatic proof that we can also unmake deserts. . . . The cost of unmaking this particular desert was $131,250. Army engineers officially estimate that if they had had to use the alternative route, the cost would have been at least $1,500,000 more."

Old West Lives Again in LU Projects



Working together, a group of livestock operators brand and vaccinate calves out on the open range. This is on one of the common-use pastures in one of the land utilization projects in the Northern Great Plains.

By O. E. McCONNELL

A tradition of the Old West was the use of rangelands in huge, unfenced areas. It may have been haphazard and uncontrolled, but the system had the advantage of flexibility. To some extent, this tradition of the Old West is being revived in the land utilization projects in the Northern Great Plains through the development of common grazing areas.

Common grazing is the term applied where two or more operators graze their livestock on the same range at the same time. Cattle belonging to several operators run at large and intermingle. Sheep are herded in bands by individual owners, or a band may be made up of several small flocks belonging to different people. Brands identify the individual ownerships. Under present land ownership patterns, not all units lend themselves to common grazing but to the extent that it is practical this plan is fostered in the land utilization projects.

Until the introduction of barbed wire fences common grazing was practiced as a necessity on the Public Domain lands before enactment of the Taylor Grazing Act. Frequently it led to bitter argument and combat between cattle and sheep operators and a consequent segregation of cattle and sheep ranges. Nevertheless, although cat-

Here's a well-bred youngster receiving the owner's brand and being vaccinated against disease.

tle and sheep are able to thrive together on the same range, sometimes in the past their owners have been unable to do so.

In those areas which were heavily homesteaded, the open or Public Domain lands that remained were in small scattered tracts and common grazing had almost disappeared. This trend has been still further accentuated in the last few years of abundant moisture, increased vegetation, increased numbers of livestock, higher prices for livestock and plentiful supplies of ready money, following the period of drought, low prices, abandonment of lands and a heavy relief load, which have witnessed the swing by a large number of operators in the Northern Great Plains toward individual grazing allotments and fenced-in units

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EDITOR'S NOTE.—The author is chief, land management division, Soil Conservation Service, Lincoln, Nebr.

—contrary to the currently popular song, "Don't Fence Me In."

The years when the Federal government had to purchase a large percentage of the livestock and furnish relief of all kinds, with lands tax delinquent in several states and going back to county ownership in wholesale lots, are still remembered by some of the people. And a considerable blocking in of units by the purchase of county and other lands is taking place. Ranchers are taking advantage of the opportunity to buy the land they need while they have the money to pay for it.

Whether common grazing or the individual-unit system is most economical in the long run seems to be of secondary importance to those men. Perhaps those ideas born of our way of life, which makes us Americans and in turn makes the United States what it is—that indescribable feeling we call independence, freedom, "mine to do with as I please"—has more to do with the individual's desire for a little domain he can call his own without undue outside interference.

The land utilization projects, however, are also furnishing the opportunity for demonstrating that people can still work together and gain the advantages of cooperation which is also a part of our way of life.

The Soil Conservation Service is custodian for 4,600,000 acres of lands in North and South Dakota, Nebraska, Kansas, Wyoming and Montana, which were purchased by the Federal government under Title III of the Bankhead-Jones Farm Tenant Act. These lands are the nucleus for 18 land utilization projects totaling 20,000,000 acres and embracing also privately-owned, county, Public Domain, and state lands. They are principally grazing and commensurate feed-base lands.

Roundup on one of the common-use pastures, preparatory to branding on open range.

Practically all of these lands, including the government-owned acres, are administered by 44 local governing bodies—grazing districts, soil conservation districts or grazing associations, organized under state law. The 156 common grazing areas which have been set up total 5,000,000 acres—1,600,000 acres of which are Title III lands. The areas vary in size from 2,000 to 70,000 acres, each accommodating the livestock of from 2 to 28 operators which totals 100,000 cattle, 150,000 sheep and 6,000 horses. Some of the grazing districts have no common grazing; in others, nearly all of the summer grazing lands are used in common. Many of these smaller operators are located so that the pasture needed for summer grazing is not available close to the headquarters. Where this is true, the common grazing area is the solution of their difficulties—a place to put their stock where it will be properly cared for, even though quite far from the headquarters.

Developments on the lands within the common grazing areas have been carried on cooperatively by the districts and Government. These include the construction of corrals in many of the common grazing areas, dams and wells and some dipping vats. It is planned to have corrals in all of the larger common grazing areas to facilitate branding, vaccinating, rounding up for shipment, and so forth. For some of the larger areas, the districts employ range riders to look after livestock and maintain the improvements. Extra district fees, above those charged by the government for the forage, are charged for the additional service where salt is furnished, riders employed and improvements maintained. All this work is necessary for handling livestock, whether it be done individually or in groups.

Increasing the quality of stock produced on the common grazing areas is centered in the bull committees provided for in each district's by-laws. The committee is either elected or appointed by the district board of directors, and usually one of its members is the county agent or some other person trained in agriculture. The other members are experienced operators. The duty of the committee is to pass upon the quality and conformation of all bulls turned into the common grazing areas. The use of inferior bulls is discouraged or not permitted in these pastures.

In some districts bulls must be registered animals of the breed decided upon by the majority of the operators using each pasture. While bulls owned by some of the better operators are of higher quality, those generally in use now in common grazing areas are average quality or better and the quality of the cattle as a whole has been increased materially. Of course, not all bull committees have made the same progress. Some are doing an excellent job; others are still somewhat lax. The present higher prices of better bulls has retarded all the progress desired in this direction. An operator, however, may use an inferior bull so long as he keeps it within the confines of his own fenced unit.

Common grazing saves much, perhaps an average of 50 percent, in fence construction and maintenance. The extent of the saving depends on the size of the common grazing area and the number of operators it accommodates. Savings in water developments are about the same. Since livestock water is one of the important limiting factors governing use of the range in the Northern Great Plains, it deserves careful consideration. In addition to the savings in the construction and maintenance of fences and reduction in the necessary number of water developments, compared with individual fenced units, common grazing permits taking advantage of better sites for water developments. Thus, better located and more dependable livestock water supplies result.

The common grazing system has some district advantages in addition to cost savings for the smaller operator. It has a tendency to get people and communities in the habit of working together, which makes for a better community in which to live. It also leads to the adoption of one breed of livestock in a community. There are several good breeds, but standardizing on one breed in a community is nearly always better than a helter-skelter intermingling of two or more breeds.

Further, grazing is better controlled with respect to season of use and degree of stocking in the common grazing areas than where the land is divided into individual fenced-in units. This better management increases the chances for continued forage production at a high level.

Last, but by no means least, the use of common grazing areas acts to protect the winter feed supplies. Usually the common grazing areas are located some distance from the headquarters, so that the stock are out of the way during the summer grazing season, which is also the growing season for feed crops. Operators, then, are free to go about the business of raising the feed needed to winter the livestock. Likewise, pasture reserved for winter use is not grazed, and is waiting for the stock when they are brought back from summer range. Too often, in individual units, pasture

The branding irons of 10 different owners are in this fire.

which should be reserved for winter is used in summer. This creates a scarcity of winter feed. The result, in many cases, is winter range used beyond the safety point and damaged, and livestock in poor condition.

Thus, through cooperation, the operator of a livestock unit is enjoying some of the tradition of the old West through cooperation with others in land utilization projects. He is, at the same time, gaining the protection arising from locally controlled use of the grasslands. And he is pointing a way for other communities who may wish to solve similar land used problems.

Purebred bulls acquired by grazing association in effort to improve quality of livestock in area.

Corrals in which to separate animals for branding, vaccinating and dehorning, and for cutting out stock to be shipped, are a regular feature of the common-use pastures on land utilization projects. Here cattle for shipping are being separated from the foundation herd.

FIGHTING FERN WITHOUT FIRE

The fern-covered areas are a constant fire hazard until converted to productive use. Some lands can be cropped or put into permanent pasture. Slopes like that in the background are often suitable for timber.

By ALBERT ARNST

In the Douglas fir region of the Pacific Northwest grows a plant that is a blessing to foresters and a curse to farmers.

It is fern (*Pteridium aquilinum var. pubescens*)—also called bracken, brake fern, western bracken and hay brake. It has no commercial value; but the successful growth of Douglas fir, western hemlock, spruce and western red cedar seedlings depends upon its shade and protection in many areas. The problem, then, is how to eradicate this troublesome plant from farmland without resorting to fire that spreads into adjacent seedling forest areas and destroys tomorrow's timber crop.

Bracken fern is an insidious and persistent resident of cutover lands and forest intermingled rural areas. It is found anywhere and everywhere in that region, chiefly west of the Cascade Mountains, and grows luxuriantly in the Coast Mountains of Oregon. It clings to farmland and pasture land with a tenacity that matches the fury of the farmer who seeks to stamp it out, and it clothes logged and burned forest lands with a dense cover which frequently tops a man's height. Tall tales are told of farmers' livestock lost in fern fields and of foresters cruising the swaying stalks, but even Paul Bunyan agreed that the plant reaches amazing heights.

The plant reproduces by means of creeping root stocks buried deep in the ground and also by spores carried in the characteristic small brown pustules on the underside of the fronds. In its proper place on forest adapted lands fern is a valuable nurse crop for tender seedlings getting started on recently logged and slash burned areas. Extended studies by foresters have shown that fern shade nurtures more trees and bigger trees. Once the trees get above the fern canopy, they eventually shade it out and finally eliminate it from the timber stand.

But fern is a menace to land use managers, particularly in soil conservation districts, because in winter and early spring it becomes a serious fire hazard. The tall stalks die out in fall and eventually are broken down by wind and rain. Crumpled to the ground in densely interlaced masses, they dry out rapidly under changing humidity and

EDITOR'S NOTE.—The author is forestry specialist, Soil Conservation Service, Sedro-Woolley, Wash.

weather conditions. When tinder dry, they constitute a dreaded "flash fuel," which, when touched off by a spark, will carry fire with utmost swiftness.

In the fire's wake may be found the thousands of little scorched trees that, unseen to the casual glance, were snuggling under the fern for protection. Fern fires also consume larger trees and destroy much wildlife. During deer fawning season, fires kill fawns, or perhaps nesting game birds, such as grouse, quail and Chinese and native pheasants. Burning fern destroys ground cover which has food value for wildlife, and it also muddies clear streams with erosion runoff. No one profits when a fern fire races across a distant slope.

Of additional interest to farmers is the fact that fern, growing or dried, is considered poisonous to horses, sheep and cattle. Sunlight seems to aggravate the poisoning effect, which results in loss of control of the leg muscles, constipation and eye pupil dilation, but causes no fever. Fern, therefore, has no place in conservation farming, because its presence on agriculturally adapted lands is a sign of improper land use.

So-called burning weather in February and March makes match-happy ranchers squint at fern fields with fire in their eye. Soil conservation districts in fern areas therefore must face fern-burning realistically, for some ranchers are potential "fernomaniacs." Statistics show that most fern fires start primarily on agricultural or assumed agricultural lands, and through carelessness, spread to nearby fields of fern-protected tree seedlings.

John Farmer generally burns fern, not to get rid of trees, but to eradicate the fern, which bothers his farming. Fire is his tool, because no one has given him a better weapon. To eliminate fern fires, the rancher must be shown a superior way to do something he will do anyway; and, furthermore, he must be convinced that on some land it is not sensible to fight fern with fire or any other method. Both the rancher's and the public's

Ferns actually nurse young seedlings like this one to the point where they can fight their own way up in the world —if they are lucky enough to escape fire.

Fire kills trees but not ferns. Lustier than ever, the ferns come back after a hot ground fire has destroyed all other growth and the surface layer of humus and duff.

appreciation of land values needs to be improved.

Each year in the Douglas fir region of the northwest, the Keep Oregon and Keep Washington Green Committees, through their cooperating agencies, carry on an active "Don't Burn Fern" campaign by press, radio and poster. A still more positive approach, equally convincing to farmer and forester, is demonstrating that fern can be banished from pasture or crop land more effectively by not using fire, and that better tree crops will mature sooner if fire is eliminated.

In soil conservation districts, soil inventories and land use capability classifications are front line weapons in the skirmish with fern burners. These indices rate the best long-time productive capacity of each farm field as determined by soil, erosion, slope and climate. They also show where crops can be grown successfully and where permanent vegetation, like trees or grasses, should replace row crops. This down-to-earth information proves it is not reasonable to develop remote "pasture" on fern covered timber growing soils, if better soiled fern land nearer the farmstead can be improved permanently with far less effort.

Fern can be licked by not using fire. On soils adapted for pasture and on tillable slopes, plow the land deeply and then harrow out, pile up and burn the rootstocks. Cultivate the land frequently during the remainder of the season or grow a row crop. Effective anti-fern treatment is the growing of oats and vetch, cut early for hay, followed by summer fallow.

Mow and clip slopes that are not too steep for handling in this manner. Run the mower over the green fern patch around July fourth and again later in the season. This bleeds the plant and retards its recovery, because the bracken is hit while manufacturing food for its buried rootstocks.

Fern burning may be sanctioned as a one-time treatment on still steeper land, if it is adapted for permanent pasture and if the rancher will follow the fire warden's advice. Burn in the fall, seed immediately to permanent grasses and pasture them when they become established. Fern-hating sod formers are used—Chewings fescue, alta fescue, creeping red fescue, highland bentgrass, orchardgrass and tall oatgrass. Annual grasses have no value for fern control.

These fern eradication techniques save trees. The field formerly torched may not have had little trees in it, but probably it bordered on a steeper slope bristling with fern-sheltered seedlings. Fire kept out of the first field also would have been kept out of the second.

Tree farmers are shown hundreds of seedlings snuggling under the dried fern. They learn that repeated fires kill all trees, impoverish soil and stimulate fern growth, because the rootstocks escape injury. They appreciate unburned fern as a nurse crop in growing timber on forest adapted lands. They know that tomorrow's timber crop may be found under today's fern patch, and that some day some community and some industry is going to benefit from the harvest of the matured trees.

Europe's Needs Reported

"The needs of Northwest Europe's liberated areas are grave, not only from a humanitarian aspect, but because they involve internal and international political considerations. The future permanent peace of Europe depends largely upon restoration of the economy of these countries, including a reasonable standard of living and employment. United States economy, too, will be deeply affected unless Northwest Europe again resumes its place in the international exchange of goods and services.—From report of Judge Samuel I. Rosenman to President Truman.

GROWING PEANUTS THE CONSERVATION WAY

This field is stripped with eight rows of peanuts and four of legumes, of which the two rows outside are crotalaria and the two inside are brabham cowpeas.

By W. M. NIXON

Peanuts, used in products ranging from soap to plastics and anti-freeze, grow best in the West Cross Timbers sector of Texas and Oklahoma when they are produced the conservation way—with a complete soil conservation program, farmers in the area have found.

The problem of producing peanuts without depleting the land of this area, which already classed as critical from the standpoint of soil blowing and washing, faced farmers when the War Food Administration first asked for increased production. The application of a complete soil conservation program for each farm has resulted in increased production of peanuts while maintaining and improving soil fertility.

Combating the potential blow-off of fertile topsoil is one of the chief problems in the West Cross Timbers. Farmers here rely on a program of crop rotation, proper management of crop residue, strip cropping, contour farming, and cover and soil-improving crops to prevent loss. Terraces are constructed on those areas where water erosion is a problem.

W. A. Maples is a cooperator with the Upper Leon Soil Conservation District. With the assistance of Soil Conservation Service technicians, he has established a complete soil conservation program on his farm, 10 miles northeast of Rising Star, Tex. This program paid off to the extent of a 70 percent increase in peanuts and an 85 percent increase in hay production in 1944.

Mr. Maples produced an average of 44 bushels of peanuts per acre in 1944 following crotalaria strips. He obtained 30 bushels per acre where peanuts followed peanuts.

Some of Mr. Maples' practices to secure better harvests include interplanting cowpeas and sorghum in strips alternating with strips of peanuts. The sorghum and pea strips afford protection against wind erosion. The peas supply nitrogen which keeps the sorghum from having a detrimental effect upon the following crop. He has used phosphate on winter cover crops of rye mixed with hairy vetch or Austrian winter peas. The cover crop was broadcast ahead of peanut digging. The hairy vetch and Austrian winter peas produce nitrogen, one of the most expensive fertilizer elements, now scarce because of its extensive use in manufacture of explosives. Mr. Maples has practiced late land preparation on deep blow sand, and he cuts his strips of sorghum stalks so they remain near the surface of the soil, forming a trashy mulch which conserves moisture and gives protection from hard rains and high winds. His experiences are typical of this area, where sandy soil, subject to severe wind erosion, predominates.

H. H. Lawson, cooperator with the Brown-Mills Soil Conservation District near Rising Star, Tex.,

EDITOR'S NOTE.—The author is regional agronomist, Soil Conservation Service, Fort Worth, Tex.

Typical of many fields of the West Cross Timbers area, where conservation measures are not used on peanut lands. After harvesting the fields stand bare and topsoil drifts to fence rows. A faint wash in the center of the field, which had been solidly in peanuts for two consecutive years, indicates both water and wind erosion.

uses a cover and soil-improving crop of rye and vetch to prevent blowing and washing. Organic matter and nitrogen are added to the soil when the crop of rye and vetch is turned under as green manure.

Mr. Lawson got 26 bushels of peanuts and 880 pounds of hay per acre from peanuts following rye alone. The peanuts following fertilized rye and vetch produced 44 bushels per acre and 1,628 pounds of hay. While the yield from the peanuts following rye alone produced at an above-average rate, the crop Mr. Lawson harvested following addition of vetch and application of fertilizer showed an appreciable increase.

An effective strip-cropping system for the Texas-Oklahoma Cross Timbers section consists of 4 to 8 rows of peanuts and 4 of corn, sorghum or crotalaria.

Grain sorghum grown on the contour in strips of 4 rows alternating with 8 of peanuts gives good protection against wind erosion. A rotation is provided by moving the strips each year.

The farm of C. M. Caraway, Sr., 6 miles east of DeLeon, Tex., provides a good "before and after" example of the benefits of peanut grown the soil conservation way. Mr. Caraway is a cooperator with the Upper Leon Soil Conservation District and also is a member of the State Soil Conservation Board.

On land planted continuously to peanuts for 10 years, he harvested 7 to 8 bushels of peanuts and 10 bales of hay per acre. On a field where the soils and slopes were similar but where such practices as contour cultivation, cover and soil-improving crops, and crop rotations have been in use about 20 years, Mr. Caraway got a yield of 30 bushels of peanuts and 30 bales of peanut hay per acre.

IMPROVE GRASSLAND FOR BETTER LIVESTOCK

By R. H. LUSH

The necessity for providing sufficient food for civilians, for our armed forces, and, in so far as possible, for our Allies and the liberated peoples is self-evident. It gives new emphasis to the desirability of feeding the soil to improve grasslands. A well-fed soil produces strong plants which, in turn, contribute largely to the health of livestock. Completing the cycle, livestock and livestock products normally furnish a large proportion of the energy, the protein, the phosphorous and particularly the calcium in the average diet.

More livestock products are needed, but there is a shortage of hay, protein feed and labor with which to make the greatest production under normal methods of feeding. Of the total feed consumed by animals during the 3-year period of 1938-40, hay, pasture and other forage crops supplied approximately 60 percent. Emphasis should

Editor's Note.—The author is pasture specialist, The National Fertilizer Association, Washington, D. C.

be given to increasing this part of the feed supply, especially for cattle and sheep, and management systems devised which would make it possible for hogs and poultry to obtain 25 percent of their feed and nearly 50 percent of their protein from grazing crops.

Experimental results are available in nearly all of the States to show this to be entirely practicable. Furthermore, the cost of producing feed in the form of pasture and hay is considerably less than the cost of producing grain, and this is especially true of the labor cost. Results of many experiments indicate that yields of pasture and hay can be increased greatly by the proper use of fertilizer and lime where it is needed, and that the increases obtained are profitable.

Of the total land area of the United States, slightly more than half is in grass, of which only 7 percent is in plowable farm pasture, slightly more than that in farm woodland pasture, and about 20 percent in other pasture. The rest is State and Federal grazing land. Of the 130 million acres of plowable pasture land most likely to be improved, 80 million are in the 31 States east of, or bordering, the Mississippi River, and in the three Pacific Coast States. These States include 65 percent of the Nation's livestock but have only 1.2 acres of plowable pasture per animal unit. Including the 100 million acres of other pasture there are only 2.7 acres per animal unit.

Millions of these acres are in areas of variable rainfall where the addition of fertilizer might not be economical in some seasons. Other millions are in the Middle West, where lack of soil fertility is presently becoming a serious problem in the maintenance of high yields. Much of the pasture acreage is abandoned cropland too poorly drained or too seriously eroded to be made quickly productive. Soil conservation surveys show that, although 398 million acres are available for crop production in the United States, 40 million of these are unsuitable and should be retired to grass and woodland; another 350 million acres of land are subject to impoverishing erosion. Abandoned and eroding cropland needs to be retired to perennial grasses or to grasses and legumes. This throws a heavier load of production on remaining crop and pasture acres.

More efficient use should be made of the present crop acreage, along with conservation of "waste" areas. Farmers need range animals of the West as well as home-raised livestock, to convert some grain and forage into highly nutritious and palatable food, to help maintain soil fertility, to distribute labor, save transportation, and to add to income. The use of pasture saves labor and protein feed, supplies adequate quantities of known vitamins and most minerals where the soil is fertile or fertilized, aids in sanitation, conserves soil and farm machinery. Moreover, pasture is usually available when needed most and is the cheapest feed for all classes of livestock.

Improvement of pastures and hayland by use of fertilizer and lime has progressed rapidly during recent years. In 1929, less than 200,000 tons of fertilizer were used on about 2 million acres of pasture and hayland; in 1942, nearly 1,300,000 tons were used on about 11,000,000 acres; 1,500,000 tons in 1944. But this is only a start. A postwar planning committee of the U. S. Department of Agriculture has suggested that nearly one-half of the total commercial plant food should be applied to grassland and other close-growing crops. The National Planning Association reports that 5 times as much fertilizer could be effectively used on pastures and haylands as in 1942.

About one-twelfth of the combined plowable pasture and hayland acreage is now being fertilized. There are millions of acres of non-plowable pasture that might be fertilized profitably. Still other millions of acres of supplementary pasture and hay crops are fertilized but little, if at all.

A compilation by the War Food Administration of many experiments with fertilizer on pasture and hay crops shows that each pound of plant food used in the form of complete fertilizer brought about an increase of from 11 to 22 pounds of dry matter and 1 to 3 pounds of digestible protein. Large increases were obtained in the Northeastern and Southern States. The chief response in the Western States was to the use of phosphoric acid. There were wide variations between States and between experiments. Each pound of nitrogen, of which there will be a large supply in the future, made possible from 14 to 20 pounds of digestible nutrients, containing 1.8 to 3.1 pounds of digestible protein—a very profitable exchange for feed.

With the high cost of labor and of legume seed, it is now desirable to prolong old legume stands by fertilizing or by reseeding with an adapted grass mixture, such as bromegrass, orchardgrass, timothy, or ryegrass. This will give additional hay and grazing, with a somewhat longer rotation. In postwar farming it may be that the quickest and cheapest way of obtaining additional feed will be to apply liberal quantities of complete fertilizer to new and old sod crops, supplemented by nitrogen top dressing. The fertilizer not only in-

creases the yield but also insures that better soil cover which aids in erosion control.

More than 40 million acres of small grain are seeded annually in the States where there is sufficient rainfall to insure profitable results from fertilizer use. It is estimated that fully 5 million of these acres are seeded primarily for grazing or hay or soil improvement. Fertilizer applied at seeding time insures a better stand, an earlier fall cover and consequent soil protection, fall grazing and, in the South, winter grazing. In general, there is less winter killing. If animals are kept off the fields in wet weather, some winter and early spring grazing can be obtained without reduction of grain yield or injury to new seedings. Feed thus obtained is cheap. It supplements permanent pasture and roughage feeding, aids in manure distribution, and for dairy cows insures better quality of milk.

Animals thrive according to the extent to which the soil supplies the essential elements to grains utilized as feed. Past emphasis has been given to the development of vegetation by crop species and tonnage yields, rather than by nutritive values. Yet, poor soils make poor feeds and unprofitable livestock. A depletion of fertility in pastures is constantly under way. Each pound of meat, each quart of milk, removes plant food from the soil.

Better nutrition should start at the grass roots, with deficiencies made up by increasing the supply of nutrients. At Joliet, Ill., a ton of bluegrass hay from a plot treated in early spring with complete fertilizer contained 435 pounds of protein and 6.4 pounds of phosphorus, as compared with 205 pounds of protein and 3.6 pounds of phosporus per ton of hay from untreated land.

When soil treatments were made in Missouri on adjoining plots, their effects were registered in sheep as differences in animal growth per unit of feed consumed and as variations in the quality of the wool. At the Georgia Experiment Station beef cows on permanent clover pasture treated with limestone and phosphate produced a 100 percent calf crop two years in succession as compared with only 50 percent of a calf crop for cows on unfertilized pasture. Almost as striking differences occurred on fertilized and untreated ranges of the King Ranch in Texas. A blind horse in Ohio grazed only to the edge of the fertilized pasture area and avoided the untreated grass. Animals have "horse sense" about feeding, but farmers have only recently become aware of the differences in feed due to soil fertility. The addition of plant food to the soil where it is necessary might be termed as livestock health insurance, as well as profitable practice.

Grain must, of course, be fed to fattening hogs and poultry, heavy-producing dairy cows, some work stock, and livestock not on farms. All other livestock can use a larger proportion of forage crops, if every effort is made to give more days of good grazing on each pasture acre, and to harvest a higher quality and yield of hay.

WATER STORAGE IN THE SURFACE SOIL

By O. R. NEAL

The matter of soil-water relationships has been the subject of extended investigations on the part of soil physicists for many years past. In Bauer's *Soil Physics* investigations on physical properties of the soil in general and on moisture relationships in particular are traced from the work of Davy in 1813 and Shubler in 1833 up to the present time. The first extensive studies on physical properties of the soil were made by Wollny between 1879 and 1898.

Wollny studied the properties of soils with a view to the effect on plants. He was able to present a reasonably accurate picture of the importance of soils and plants on the disposition of rainfall or, in modern terminology, the role of soils and plants in the hydrologic cycle. He measured the interception of rainfall by vegetation and studied the protective effect of vegetative canopy on surface soil porosity. He measured the quantities of runoff and erosion from plots of different degrees and direction of slope, with different soil and crop conditions. Lysimeters were used to study the movement of water through soil under different crops and treatments. A surprising number of recent contributions in the fields of hydrology and conservation are actually only confirmations of Wollny's original work.

During the period of Wollny's work in Germany several American investigators were concerned to a greater or less extent with soil moisture studies. The best known of these were Hilgard of California and King of Wisconsin. King is generally recognized as the father of soil physics in this country. His book entitled *Physics of Agricul-*

EDITOR'S NOTE.—The author is project supervisor, Soil Conservation Service, New Brunswick, N. J.

ture enjoyed widespread popularity and is of interest at present, particularly in connection with the author's view on soil moisture and tillage problems.

Beginning at about 1900 there was a marked decrease in research and presumably in interest in physical properties of soils. From that date up to about ten or fifteen years ago, most of the soil physics work in this country was done in the Bureau of Soils. Briggs, McLane, Shantz, Buckingham and others made notable contributions during this time, particularly in the field of soil moisture properties. Briggs and his associates developed the moisture-equivalent technique as a measure of the ability of soils to hold water. They also introduced the concept of the wilting coefficient to express the moisture content of the soil at which plants permanently wilt. Veihmeyer and Hendrickson suggested the term field capacity to designate the moisture content of the soil after the rate of downward movement of added water had decreased to a very low value.

In any practical consideration of soil moisture in relation to crop growth, whether the moisture is supplied by natural precipitation or by irrigation, the field-capacity and wilting-point values are of considerable significance since they mark the upper and lower limits of soil moisture usable by plants. In any particular soil each of these values is more or less fixed as a result of the physical nature of the soil. Treatments which tend to increase the field capacity usually result in a more or less equivalent increase of the wilting point. As a result, the quantity of water that the soil can hold for use by plants is not materially changed.

When water is added to the surface soil, it moves downward only as each successive layer of soil is raised in moisture content to the field capacity. It is not possible to raise the moisture content of the surface foot, for example, by a small amount and have the added moisture distributed uniformly through the layer. Rather the added water will all be held in the top one or two or three inches depending on the amount added. In a soil weighing 90 pounds per cubic foot and having a field capacity of 35 percent, approximately 6 inches of water can be held in a surface foot of soil. If the soil were completely dry, as is rarely if ever the case, an application of 2 surface inches of water would all be held in the first four inches of soil. Under actual field conditions the moisture content at the time of water addition would be somewhere above the wilting point, with the result that from 2 to 3 inches of water would be present when the addition was made. Under these conditions 2 inches of added water would wet the soil thoroughly to a depth of about 8 inches.

THE GIST OF IT

This article points out that certain moisture constants of the soil are of particular importance in connection with irrigation. The two most important are field-capacity and wilting-point. The field-capacity, for all practical purposes, represents the only moisture content that can be induced in field soils by the addition of water. The wilting-point represents the condition below which plants are unable to obtain water at a rate sufficient to support growth processes. The range between the two values represents the quantity of water that the soil can hold for use by plants.

It is observed that water losses by evaporation are limited largely to moisture held in the surface layer. Attention is directed to this fact in the planning of irrigation applications.

Also noted are the effects of irrigation practices on physical properties of the soil, organic matter content, and general soil productivity. The need for adoption of effective conservation practices in connection with the use of supplemental irrigation is emphasized.

Losses of moisture by evaporation from the soil surface occur largely at the expense of the water held in the surface 6 to 8 inches of soil. There may be a limited amount of water lost by evaporation from greater depths but the quantity is not of great practical significance. Losses from the surface layers, however, may be high. There is experimental evidence that losses of from 0.20 to 0.25 inch per day are not uncommon when the immediate surface of the soil is wet. In a lysimeter experiment conducted several years ago two soils of quite different profile characteristics were compared in respect to quantities of water lost by evaporation. A soil that was uniformly permeable throughout the column lost an annual average of 54 percent of the precipitation as surface evaporation.

The second soil which had a relatively impermeable layer at a depth of about 9 inches lost 71 percent of the precipitation. Presumably the impermeable layer tended to hold more of the water near the surface where it was subject to evaporation. The classical experiment in this connection

was reported by Veihmeyer a few years ago. He filled containers having a depth of about 30 inches with moist soil, then exposed them to evaporation but protected them from rainfall for periods varying from 80 to 167 days. At the expiration of such periods the dry soil on the immediate surface was mixed with the underlying soil and a crop of vetch was grown without the addition of water. These results indicate clearly that evaporation losses are limited to water held in the immediate surface layers.

In agricultural operations where rainfall alone is depended upon as a source of water the foregoing information concerning water-holding capacity of the soil and the losses by evaporation are of academic interest but have no direct field usefulness since the amount and time of water application cannot be controlled. *In the case of supplemental irrigation, however, the situation is entirely different.* The rate and quantity of water application can be manipulated in whatever fashion produces the greatest economic return. In connection with evaporation losses, for example, it has been shown that water is lost in appreciable quantities from only the surface few inches of the soil regardless of the total depth of water penetration. In a particular soil a 1-inch application of water might be held entirely in the surface 5 inches where it would be subject to rapid evaporation loss. Under the hot, drying conditions that often obtain during periods when irrigation is needed, it is conceivable that a large fraction of the added water would be lost in the course of a week. When another irrigation was made the process would be repeated. Only a small fraction of the added water would be available to plants under this condition. If, on the other hand, 2 inches of water was applied at the time of the first application the depth of penetration might be 10 to 12 inches. Surface evaporation would still be limited to the surface 5 inches, more or less, and all the water below that depth would remain for plant use. The efficiency of the operation from the standpoint of quantity of water actually made available for plant use would be considerably more than doubled by this procedure. The foregoing statements concern only the efficiency of water use and do not take into account the use of labor, quantity of pipe required, rate at which water can be obtained, and other factors.

Research information is sorely needed and, to my knowledge, is not available on many of the factors involved in the practice of supplemental irrigation. The rate at which water can be applied safely to different soils under different conditions of cover is not known. Presumably it is desirable from the standpoint of the operator that water be applied as rapidly as possible without producing runoff. Time required for application of a unit quantity of water would be greater with heavy applications than with light ones. When water is first applied to a cultivated surface it is absorbed very rapidly, but the rate of entry decreases as the period of application is lengthened. In the case cited above concerning the application of 2 inches of water instead of 1 inch, the time required would doubtless be considerably more than doubled. Contouring, terracing, mulching, and other conservation practices will increase the rate of water penetration under irrigation just as they do for natural precipitation.

Information is needed on the quantity of water that can be held in the root zone of the crops that are being grown. This might vary considerably with different soils. Simple, rapid, and moderately accurate methods are needed for determining the moisture content of soils in the field in order to determine irrigation needs. Some progress has been made along this line. Plaster-of-paris blocks which are imbedded in the soil in a suitable container and can be removed for weighing offer some promise in this connection. Tensiometers are very useful for certain moisture levels but do not operate over the entire range of soil moisture from field capacity down to the wilting point. Other equipment and methods have been proposed for the measurement of soil moisture content and have been used with more or less success. There remains a need, however, for a simple field method of determining the moisture condition in the soil with respect to crop needs. Such a method, to be ideal, will be based on the newer energy-concept of moisture measurement rather than on a mere determination of weight of water per unit of soil.

In considering the developments that may be of service in connection with irrigation activities, the possible value of long-range weather forecasting should not be overlooked. We are told that great progress has been made in this science during recent years. It is not too fanciful to envisage the use of these techniques in agricultural operations. Thornthwaite and his associates have recently suggested a procedure by which deficiencies of soil moisture can be determined. In the humid areas where relatively short drought periods occur at irregular intervals it would be of great benefit to the farmers if such occurrences could be predicted with even moderate accuracy. Furthermore, accurate forecasting for short periods of only a week or more would serve as a guide for irrigation.

In any discussion of irrigation problems the need for conservation practices should be strongly emphasized. It has been shown repeatedly that the deterioration of soil structure and the exhaustion of organic matter are responsible, in large part, for increased erosion on our crop lands. The very nature of the irrigation practices is such that these deteriorative processes will be accelerated. In our efforts to encourage the maintenance of a good supply of organic matter in the soil, we sometimes lose sight of the fact that the decomposition of organic matter is a normal and desirable process. The following is quoted from an earlier statement on this subject:

"Organic-matter decomposition, with the resulting liberation of plant nutrients, is desirable and necessary under average conditions in order to maintain the soil in a well-aggregated condition which is resistant to erosion and in order to maintain a productive condition. The accumulation of a large amount of organic material that was highly resistant to decomposition would not necessarily contribute to good physical condition of the soil and to soil fertility. The desirable condition is one where a system of crop and soil management is so arranged that additions of good quality organic materials are made at regular intervals. The normal decomposition processes that contribute to good physical condition of the soil and to high productivity can then proceed without danger of the eventual exhaustion of soil organic supply."

The need for soil management practices which will maintain organic matter is increased when irrigation is practiced. The maintenance of a favorable level of soil moisture during periods that, without irrigation, would be characterized by drought tends to increase the rate of organic matter decomposition.

Contouring, terracing and other mechanical conservation practices are highly desirable to prevent runoff both from irrigation water and from precipitation. Damage from runoff and erosion on some irrigated areas is serious. The quantity of irrigation water needed and consequently the expense of application is reduced as measures for more effective conservation of natural precipitation are adopted. It is conceivable that the apparent need for irrigation on many areas would be completely eliminated by the adoption of effective practices for the conservation of natural precipitation. Certainly, in view of both the immediate and the long-time benefits involved, adequate conservation practices should accompany the irrigation process.

ACADEMICIAN T. LYSENKO ON PLANTING OF WINTER WHEAT AND RYE IN UNPLOWED STUBBLE

Excerpts from "What is the Essence of Our Proposal Regarding Planting Winter Crops in Stubble in the Steppes of Siberia" By Acad. T. Lysenko, pp. 25-36, Sotzialisticheskoe Khoziaistvo, Vol. 5-6, 1944

Translated and Abstracted
By D. B. KRIMGOLD

Subject of lively discussion among soil conservationists of late has been the question "To plow or not to plow" Faulkner's debatable book, "Plowman's Folly," has released a flood of discussion. The pros and cons have flown thick and fast. This book has served to focus attention on a fundamental operation of farming and has spurred an interest in a topic long due more general attention. Research scientists of the Soil Conservation Service have for a number of years been investigating various methods of planting crops without subjecting them to unnecessary dangers of erosion. They have developed the so-called stubble mulch farming and have worked out a large number of variations of the "trashy cover" idea for use under a wide range of conditions.

Conservationists generally, and especially workers in the winter wheat regions of the United States, will therefore be interested in the discussion of a related subject by Academician Trofim Lysenko whom a national magazine includes among "some of the world's great contemporary scientists."

The first interesting thing about Lysenko's article is that it shows that he, the great Lysenko, is definitely on the defensive and must overcome the objections and criticisms of lesser lights. He begins his discussion thus:

"The question of planting winter crops on unplowed stubble in the prairie regions and the open sections of

EDITOR'S NOTE.—The translator is soil conservationist (research), Soil Conservation Service, Washington, D. C. The magazine "Sotzialisticheskoe Khoziaistvo" is the official organ of the Narkomzem (Department of Agriculture of the U. S. S. R.).

Siberia, Transural, and northern Kazakstan is one of national economic significance. Yet this problem faces a negative and often hostile attitude on the part of a number of agricultural workers and scientists and of agricultural agencies. This affects in certain measures the yields of cereals in these regions.

"Without entering into the essence of the difference between my proposal and the old well known method, I shall enumerate the basic reasons which are commonly given for low yields of crops planted on unplowed stubbles. These reasons are:

"1. During dry summers it is hard to obtain germination of winter crops on poorly plowed fallow. It therefore follows that for crops planted in stubble, (that is, in fields which are not worked at all after the harvest) there would certainly be poor germination. On such plantings germination can be obtained only in years with ample rainfall during the latter half of summer.

"2. Winter wheat in the prairie regions of Siberia seldom winters well even on well worked and early plowed fallow. Rye comes through well on 'black' early fallow but on late fallow, which is plowed immediately prior to planting, even rye does not winter well. Therefore, planting on fields which are not plowed at all, that is plantings in stubble would fail even worse.

"3. Plowing to a depth of not less than 20 centimeters (about 8 inches) safeguards the field from infestation by weeds. Shallow plowing on the other hand causes serious infestation. Therefore, crops planted in unplowed stubble would be infested even more.

"4. During dry summers, winter crops often suffer from lack of moisture even when planted on good black early fallow. It therefore follows that during dry years crops planted in stubble will die out altogether. This is because the moisture on such fields was not allowed to accumulate but on the contrary was being exhausted by the preceding crops.

"5. Plants feed on minerals. For proper activity of the micro-organisms which mineralize organic substances it is necessary to have air in the soil. In the absence of air there will be no plant food and the plants will starve. Working over the soil produces favorable conditions for the access of air. From this it can be concluded that crops in stubble will certainly starve. On such fields the plants will be small and will produce inferior grain.

"All the explanations brought forth above are, as far as I know, widely accepted among workers in agricultural science.

"Until the fall of 1941, I did not doubt a single one of the accepted explanations of low yields obtained from crops planted in unplowed stubble. However, in the winter of 1941 and spring of 1942 my observations of winter conditions in open unprotected fields led me to a firm conviction that in the Siberian prairies planting on fallow does not present the best conditions for wintering of crops.

"Winter wheat on fallow seldom makes a crop in the Siberian prairies because it is as a rule winter killed. It is for this reason that winter wheat is not being sown in Siberia. Rye if sown at the proper time on good fallow fields will stand the winter but even rye winters poorly or does not come through at all when sown in fields plowed too late. A number of detailed observations led me to suppose that in open sections of Siberia the best winter conditions are assured when winter crops are planted not in fallow but in stubble. At the same time the study of winter conditions in Siberia led to the conclusion that the favorable winter conditions which exist on fields in stubble can not be produced on large fallow fields.

"By the spring and summer of 1943 it became obvious that the results of the experimental seedings of winter wheat in stubble carried out under my direction on the fields of the Siberian Experimental Institute for Cereal Crops, as well as the data on yields obtained from trial seedings on several state farms, exceeded our expectations. Seedings of the more frost-resistant kinds of winter wheat on good fallow field without snow arresters were entirely lost, which is as should be expected. The highly frost resistant rye (Omka) which was planted in September was either badly affected or entirely killed. At the same time plantings in stubble of all types of winter wheat, the majority of which were of the Odessa and Crimean types which are of low frost-resisting quality, all came through the winter in excellent condition. Furthermore, on the fields of the Tcheliabinsk station and at Omsk even sprouts of spring wheat wintered over satisfactorily.

"Observations of the growth of plants and data on yields in stubble planting have shown something that we did not suspect when the experiments were started. The results demonstrated that the old, commonly accepted explanation of low yields of rye planted in unplowed stubble in Siberia were not at all valid. The causes of low yields of rye planted in unplowed stubble are entirely different and can be eliminated. Planting in stubble has always been done by the broadcast method. In spite of multiple harrowing, the rye seed was worked into the soil very poorly. The seeds of weeds which require only shallow depth were worked in much better with the harrow than were the seeds of rye. As a result, such broadcast seedings came up too late in the fall. This was especially true under conditions of drought. In the spring and summer of the following year the rye was crowded out by weeds. The horse-drawn drills were also inadequate for working the rye seed into the soil. It is only with tractor-drawn drills that rye can be well worked into the soil. With this method the seeds of weeds which lie on the surface of the ground remain in an unfavorable condition, that is, they are not worked into the soil. Such in-stubble seedings in the prairies of the Siberia not only of winter wheat but also of rye can, as the experiment showed, give yields not lower and in general even higher than the yields of crops sown on fallow and certainly much higher than the entirely unsuitable seedings of rye on fields freshly plowed in September, a practice which unfortunately has recently been widely followed in Siberia. The availability of good tractor-drawn disk drills has made it possible to advocate the old and discarded method of planting in stubble as the better method both agronomically and economically for the prairie regions of Siberia.

"Our proposition is that in the prairie regions of Siberia the planting of winter crops should be carried on in the stubble of spring crops which, in turn, were planted on fallow or sod. Winter wheat must be planted in the last third of August and not later than the first of September. Rye must not be planted later than between the fifth and tenth of September. The crop must be drilled with an adequate tractor-drawn disk drill by the criss-cross method. Tractor-drawn drills with suitable disks and springs can work in the seed properly, while leaving the stubble unbroken and without working in the seed of weeds which lie on the surface. Under Siberian conditions with the great range in day and night temperatures at the end of

August and the middle of September the heavy dew makes possible a stand even with the small amount of precipitation. It is only necessary that the seeding in stubble be done at the proper time with adequate tractor-drawn drills. Crops put in late, that is, in September and especially late in September, can not give a stand even if the crop is put in with tractor-drawn drills and even with good moisture condition. This is because of the low temperature. The results of the tests have already shown that planting in stubble gives the best guarantee against winter killing. It is therefore incorrect to say that stubble plantings of rye in the Siberian prairies are spotty and weak because the plants are killed by frost. The real reason for it is the broadcast method of sowing which, especially when done late, results in a spotty stand and causes the fields to become infested with weeds.

"Both science and experience have unquestionably proved that shallow plowing causes weed infestation. It would naturally appear at first glance that planting of winter crops in unplowed stubble carried on by the method which I propose would cause greater infestation by weeds."

"In my opinion, good stubble seedings of winter wheat and especially of rye made with tractor-drawn disk drills by the criss-cross method are not only not causing infestation but to some extent appear to be clearing fields from a number of weeds. This does not mean, however, that planting in stubble should be carried out on infested fields. On infested fields no method will give good results.

"It is our deep conviction that the proposed method will in the near future find wide application in the prairie regions of Siberia as a means of obtaining a cheaper supply of winter rye and at the same time improve fertility of the soil for crops that follow. This method of planting will be a useful means for combating soil erosion which, for a number of reasons, is an item of outstanding importance. Finally, the method which we propose makes it possible not only to prevent the loss by winter killing of a large proportion of frost resistant rye, but also opens up wide possibilities for winter wheat."

In the last paragraph Lysenko warns against misapplication of his method. He states:

"I want to emphasize that our proposition applies only to prairie and open timber-prairie regions of Siberia Transural and Northern Kazakstan. We do not recommend it in other regions, on fields surrounded by forests and therefore protected from wind."

REVIEWS

THE FARMER AND THE REST OF US. By Arthur Moore. Little, Brown & Company, Boston 6, Mass.

This book, by the editor of the Daily Pantagraph of McLean County, Ill., in the heart of the Cornbelt, may not have been intended for the farmers, but certainly many of them will read it with interest. This volume of slightly more than a couple hundred pages is intended for "the rest of us." It is a plea to those of us on paved streets to understand and to begin acting on our most pressing problem, namely, food.

Arthur Moore, the author, is rural enough to recognize the fact that food is fabricated soil fertility, and therefore a product of the farmer's industry. He is also industrial enough to appreciate how we succeeded in bringing on our high production per individual. His broad concepts enable him to discuss the two constituents of American democracy, namely, the farmer and industry, for the elimination of class strife between them and for the good of the cause of food production on the farms. His discussions of their interrelations ought to serve as an awakening experience to any city reader.

The American Farmer's passion for high prices, according to Mr. Moore, has moved farmers to town, has encouraged farm tenancy and has given the Nation its loss of soil fertility, the farmer his loss of security, and all of us the loss of a social democracy. Industrialism has gone forward, but at the cost of the soil body by erosion, as well as of its food-producing power by exhaustion, and of the human resources of the country areas. The cry for cheap food for the rest of us has been an industrial boomerang. It reduced the farmer's capacity to buy industry's products and led us into a depression with its destruction of food and fiber while some people were clamoring for them under Federal aid. The facts, this book points out, demonstrate our need for more than an agricultural economic policy, in the form of a distinctly national food policy.

This book is just what Mr. Moore intended it to be. It is a search "through industrial society for the core of facts about agriculture's relation to the rest of society." It has identified "the thorns and thistles," including both "those which flourish in Washington" and those "which have taken root on the land itself, in the mind of labor, and in industrial management." It analyzes clearly the fallacy in the common belief that "farming is a business" and suggests that "if business would look to agriculture for guidance it might settle its basic controversies, once and for all, in favor of the production man and against the manipulator of finance." In a hungry world profit is not the goal of farming. In terms of food, the farmer can not believe that he produces one hog too many. In terms of economics he is told that he does. Fundamentally, his calling is endowed with more than bookkeeping. It is, Mr. Moore says, "without a counterpart in business, trade or the professions. If we finally hit on a philosophy of farming which will protect our food resources," he says, "it will have to have much of farming's own unique character."

This book puts soil conservation on a new and higher plane, supports this activity in its bidding to become a part of a national food policy. Conservationists of any category will subscribe to his belief that "in soil conservation the people are first and the soil is second," that "we need technicians, but first we need farmers who want technicians," and that "to preserve the land, the farmers—not town-dwellers with their romantic and sentimental illusions—but farmers themselves must believe life on the land to be worth preserving."

The book is another of the recent testimonies that America is now thinking about her soil and the future food production from it. Mr. Moore has thought clearly, written forcefully but sympathetically. His fine style in writing about so universal a concern as food and food production should get a hearing from "the farmer and the rest of us." —*W. A. Albrecht*

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SOIL CONSERVATION

Index

VOLUME X

July 1944 to June 1945

United States Department of Agriculture
Soil Conservation Service
April 1947

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION -- INDEX TO VOLUME X

JULY 1944 TO JUNE 1945